



TRYPANOSOMA RHODESIENSE (STEPHENS AND FANTHAM).

A SECOND SPECIES OF AFRICAN TRYPANOSOME PRODUCING SLEEPING SICKNESS IN MAN.

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Prefatory Note.

EARLY in 1910 a case of sleeping sickness in a European from Northern Rhodesia was being treated in the Royal Southern Hospital, Liverpool. The case was studied from various points of view by Sir Ronald Ross and Dr. D. Thomson.

In March of the same year I was demonstrating the trypanosomes in the blood of a rat sent as *T. gambiense* to a class of students, when I noticed certain peculiarities in the structure of the trypanosomes. These peculiarities were so striking that I remember well telling my students to label their slides *T. gambiense* (?) as I felt certain that some mistake had been made. On inquiry I found that the rat had been inoculated with the blood of the patient in hospital, though at the time I was ignorant of this. I now proceeded to see if the forms I had observed were to be found in the ordinary laboratory strain of *T. gambiense*, but after examining the latter over and over again I was unable to find them. In a letter dated May 9th, 1910, to the Advisory Committee for the Tropical Diseases Research Fund I noted these points. In the meantime I was continuing my observations on this trypanosome, and eventually I mentioned my suspicions that I was dealing with a trypanosome that was not *T. gambiense* to my colleague Dr. Fantham, who kindly consented to help me in describing it, and before doing so to make quite certain again that *T. gambiense* did not show these forms. (J. W. W. S.)

We finally felt that our position was secure, and we read a paper on the subject before the Royal Society on November 3rd, 1910, the concluding paragraph of which is as follows:

Our own view is that we are dealing with a new species of human trypanosome for which we propose the name *Trypanosoma rhodesiense*.

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We mention these points somewhat in detail because they appear not to be generally known, but all the dates can be verified by reference to the literature.

Before summarizing the evidence in favour of the specificity of *T. rhodesiense*, we would emphasize the fact that the identification of a trypanosome is a very difficult matter, and that with our increase in knowledge the difficulty has hardly decreased; in fact, it may be stated to have increased. We must, indeed, make use of every possible means at our disposal, even though these may not be perfect. What, then, is the evidence on which we base our belief that *T. rhodesiense* is a second species of African trypanosome producing sleeping sickness in man?

1. The Morphology.

The peculiarity of this trypanosome is that in the blood of *all* subinoculated animals the nucleus instead of being in the middle or near the middle of the trypanosome, as is usually the case, is, in some of the short or stumpy forms of the trypanosome near the posterior end, more or less close to the blepharoplast (kinetic nucleus), or even on its posterior side. We believed, and still believe, that this morphological feature alone definitely enables us to distinguish the trypanosome from *T. gambiense*.

2. Animal Reactions.

Laveran sums up the question of the animal reactions as follows:

The total results correspond with those of other authors—namely, Bevan, Yorke, Fantham, Laveran, Mesnil and Ringenbach, and others, and show that *T. rhodesiense* is clearly distinguished from *T. gambiense* by its great virulence for the majority of animal species; whereas in rats and mice *T. gambiense* has very variable virulence, some animals being refractory, others contracting light infections, *T. rhodesiense* invariably kills them. In the guinea-pig, dog, and Macacus monkeys the duration of *T. rhodesiense* infections is shorter than that of *T. gambiense* infections. In sheep and goats the difference in the evolution, symptomatology, and gravity of the two infections is quite remarkable; whereas *T. gambiense* infections in these animals often give rise to no symptoms except fever (often missed if one does not take the temperature), and usually end in recovery, *T. rhodesiense* infections lead to an acute disease, with high fever, oedema and keratitis, and death is invariably the end after a relatively short duration.

3. Serum Reactions.

(a) *Action of Immune Serum* (Mesnil and Ringenbach).—

(1) A goat was infected with *T. rhodesiense*. Twenty-two days later its serum + *T. rhodesiense* was injected into a mouse. Result: Protection. (2) The serum + *T. gambiense* was injected into a mouse. Result: Infection.

(b) *Action of Baboon Serum*.—Contrary to *T. gambiense*, *T. rhodesiense* is very susceptible to human and baboon serum. Thus Mesnil and Ringenbach performed the following experiment: A dose of 1 c.cm. of baboon (*Papio anabis*) serum cured mice with *T. rhodesiense*. In the same dose it acted very feebly on *T. gambiense*.



Action of Human Serum.—One c.cm. of human serum cured *T. rhodesiense* mice in 3 out of 4 cases; on *T. gambiense* mice there was no appreciable effect.

Laveran and Nattan-Larrier have shown the same—namely, that human serums act on *T. rhodesiense*, but are quite without action on *T. gambiense*.

(c) *Trypanolytic Reactions.*—The results got by Mesnil and Ringenbach are most demonstrative in the case of trypanolytic reactions. The serums of animals (man, monkey, and guinea-pig) infected with *T. gambiense* are trypanolytic for the homologous trypanosome—that is, *T. gambiense*—but have no action on the heterologous trypanosome—that is, *T. rhodesiense*.

4. Cross Immunity Experiments.

(a) Mesnil and Ringenbach immunized a monkey (*Macacus rhesus*) against *T. gambiense*. It was inoculated with *T. rhodesiense* on June 7th, 1911; on June 27th trypanosomes appeared (the infection was slight); on July 4th it died. A control died in ten and a half days.

(b) Laveran immunized a goat and mouse against *T. gambiense*; when they had acquired a solid immunity they were inoculated with *T. rhodesiense*. They became infected like the controls.

(c) Laveran and Nattan-Larrier immunized a goat against *T. brucei*; it subsequently became infected with *T. rhodesiense*.

(d) Laveran immunized a ram and a sheep against different strains of *T. brucei*. Inoculated with *T. rhodesiense* they both acquired acute infections and died. Conclusion: *T. rhodesiense* is not *T. brucei*.

When the converse set of experiments is tried, namely, immunizing an animal against *T. rhodesiense*, and then inoculating with *T. gambiense*, the difficulty immediately arises that it is impossible to immunize an animal against *T. rhodesiense*, owing to its virulence. But a partial and transitory immunity to *T. rhodesiense* can be got by treating the infected animal with drugs, such as arsenophenylglycin. The results, so far as they go, seem to show that an animal immunized against *T. rhodesiense* is immune not only to *T. rhodesiense*, but also to *T. gambiense*, a fact which, according to Mesnil and Leger, does not invalidate the specificity, but tends to show that the two trypanosomes are closely related.

5. Mode of Transmission.

Although not regarding it as an absolute specific characteristic, it is interesting to note that according to Kinghorn and Yorke (1912):

(1) *T. rhodesiense* is transmitted by *Glossina morsitans*, both in laboratory experiments and in nature.

(2) That about 16 per cent. of the wild game examined in Northern Rhodesia is infected by *T. rhodesiense*.

6. Curve of Measurements.

We have measured 2,000 *T. rhodesiense* and the curve differs from that obtained by Surgeon-General Bruce for 1,000 *T. gambiense*.

Conclusion.

When we first announced this trypanosome it seemed to be very generally assumed that it was a variety of *T. gambiense*, and that its peculiarities were due to the fact that it was probably transmitted by *Glossina morsitans*. We have never held this view, as we considered that there were no facts to warrant such an assumption. We believe that sleeping sickness in Rhodesia, Nyasaland, and adjoining territories is due to a specific trypanosome, *T. rhodesiense*; that the disease is not due to *T. gambiense* recently introduced, on the contrary—though this may be difficult to prove—that it has existed in these territories from time immemorial.

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